

## PATENT ABSTRACTS OF JAPAN

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### (54) **ELECTRIC DOUBLE LAYER CAPACITOR**

(57)Abstract:

PURPOSE: To provide an electric double layer capacitor having a high energy density and a low inner impedance.

CONSTITUTION: Polarizable electrodes 8 containing a porous element 12 having activated charcoal 9 and fluorine resin 10 and communicating holes 11 and electrolyte, are provided on both side surfaces of an electrolyte permeable and non-electron conductive separator 7, and collectors 14 are provided on the surfaces of the electrodes 8.



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**CLAIMS**

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[Claim(s)]

[Claim 1]An electric double layer capacitor which provided a polarizable electrode which consists of a porous body which has a communicating hole which consists of activated carbon and a fluoro-resin, and an electrolysis solution in both sides of a separator of non-electron conductivity by electrolyte permeability, and provided a collector in the surface of the polarizable electrode.

[Claim 2]A polarizable electrode which consists of an electrolysis solution which consists of a porous body and tetraethylammonium fluoroborate which have a communicating hole which consists of activated carbon and a fluoro-resin of a phenol resin system, and propylene carbonate is provided in both sides of a separator which consists of glass tissue of non-electron conductivity by electrolyte permeability, An electric double layer capacitor which provided a collector which consists of aluminum by a spraying process in the surface of the polarizable electrode.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to an electric double layer capacitor.

[0002]

[Description of the Prior Art]There is a thing of composition of that an important section section shows drawing 2 as this kind of an electric double layer capacitor. The polarizable electrode 5 which consists of a solvent (not shown) which consists of the binder 3 and the electrolyte 4 which consist of the activated carbon 2 and poly vinyl PIROIDON in the figure on both sides of the separator 1 which consists of polypropylene of non-electron conductivity by electrolyte permeability, and propylene carbonate is formed, It was the composition of having formed the collector 6 which consists of metallic films in the surface of the polarizable electrode 5. In this composition, if direct current voltage is impressed to the collector 6, an electric double layer will be made to the activated carbon 2 in the polarizable electrode 5, and the interface of an electrolysis solution, and mass accumulation of electricity will be carried out to them.

[0003]

[Problem(s) to be Solved by the Invention]However, in order to use the collector 6 which consists of a 20-50-micrometer-thick metallic film in order to compensate the self-shape preservation ability of the

binder 3 with the above composition, an energy density is as low as  $6 \text{ J/cm}^3$ , the polarizable electrode 5 — a mixture with the activated carbon 2, the binder 3, and the electrolyte 4 sake — an electrolyte — the inside of a polarizable electrode — osmosis — hard — there was a problem that the internal impedance at 120 Hz was as high as 1 ohm.

[0004]This invention solves the above-mentioned problem, and its energy density is high and it aims at offer of the low electric double layer capacitor of internal impedance.

[0005]

[Means for Solving the Problem]In order to attain the above-mentioned purpose, an electric double layer capacitor of this invention has composition which provided a polarizable electrode which consists of a porous body which has a communicating hole which consists of activated carbon and a fluoro-resin, and an electrolysis solution in both sides of a separator of non-electron conductivity by electrolyte permeability, and provided a collector in the surface of the polarizable electrode.

[0006]

[Function]While the self-shape preservation ability of a polarizable electrode becomes high and can reduce the thickness of a collector by the above-mentioned composition, an electrolyte permeates the inside of a polarizable electrode easily.

[0007]

[Example]Hereafter, the example of this invention is described based on an accompanying drawing.

[0008]In drawing 1, 7 is a separator which consists of glass tissue of non-electron conductivity by

electrolyte permeability. 8 is a polarizable electrode which consists of the porous body 12 which has the communicating hole 11 which consists of the activated carbon 9 and the fluoro-resin 10 of a phenol resin system, and the electrolyte 13 which consists of tetraethylammonium tetrafluoroborate. A solvent is propylene carbonate and has dissolved a 0.1-mol electrolyte into the 1-l. capacity. The ratio of the activated carbon 9 and the fluoro-resin 10 was set to 1:9 by the weight ratio.

[0009]The collector 14 which consists of 1-micrometer-thick aluminum was formed in the surface of the polarizable electrode 8 by the plasma spray process. According to the electric double layer capacitor of the above-mentioned composition, since the porous body 12 which becomes the polarizable electrode 8 from the activated carbon 9 and the fluoro-resin 10 was used, while internal impedance became low, self-shape preservation ability became high, and since about 1 micrometer of the thickness of the collector 14 could be sufficient, the energy density became high.

[0010]The energy density of this example and a conventional example and comparison of internal impedance are shown in (Table 1).

[0011]

[Table 1]

	エネルギー密度 ( J / cm <sup>3</sup> )	内部インピーダンス ( Ω )
従 来 例	6 . 0	1 . 0 0
実 施 例	2 0 . 0	0 . 0 8

[0012]The energy density of this example is 3.3 times as high as a conventional example so that clearly from the table, and internal impedance is low single or more figures.

[0013]Although the activated carbon of a phenol resin system was used as activated carbon in the example, the same effect is acquired, even if it replaces with this and uses chop-like carbon fiber, glassy carbon, graphite powder, etc. Although tetraethylammonium tetrafluoroborate was used as an electrolyte, the same effect is acquired, even if it replaces with this and uses electrolytes, such as tetraethylammonium perchlorate. Although aluminum was used as a collector, the same effect is acquired, even if it replaces with this and uses the oxide of tantalum, titanium, titanium oxide, and the precious metals, etc. Although glass tissue was used as a separator, the same effect is acquired, even if it replaces with this and uses the separator of non-electron conductivity by electrolyte permeability, such as polypropylene.

[0014]

[Effect of the Invention]According to the electric double layer capacitor of this invention, so that clearly from the above explanation. Since an electrolyte permeates the inside of a polarizable electrode easily while an energy density becomes high, since self-shape preservation ability becomes high since the polarizable electrode which consists of a porous body which has a communicating hole which consists of activated carbon and a fluoro-resin, and an electrolysis solution is used, and the thickness of a collector can be reduced, internal impedance can be reduced.

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1]The important section sectional view of the electric double layer capacitor in one example of this invention

[Drawing 2]The important section sectional view of the electric double layer capacitor in one conventional example

[Description of Notations]

7 Separator

8 Polarizable electrode

9 Activated carbon

10 Fluoro-resin

11 Communicating hole

12 Porous body

13 Electrolyte

14 Collector

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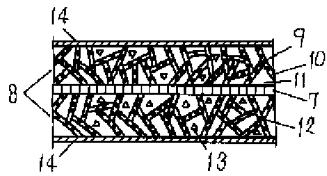
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**DRAWINGS**

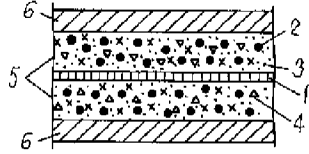
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[Drawing 1]

- 7---セパレータ  
8---分極性電極  
9---活性炭  
10---フッ素樹脂  
11---透過孔  
12---多孔体  
13---電解質  
14---集電極



[Drawing 2]



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[Translation done.]

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(54)【発明の名称】 電気二重層キャパシタ

(57)【要約】

【目的】 エネルギー密度が高く、内部インピーダンスの低い電気二重層キャパシタの提供を目的とする。

【構成】 電解質透過性で非電子伝導性のセパレータ7の両面に活性炭9とフッ素樹脂10からなる連通孔11を有する多孔体12と電解液とからなる分極性電極8を設け、分極性電極8の表面に集電極14を設けた構成。

7---セパレータ

8---分極性電極

9---活性炭

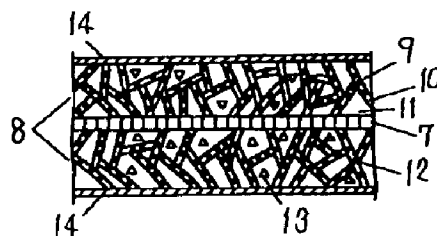
10---フッ素樹脂

11---連通孔

12---多孔体

13---電解質

14---集電極



## 【特許請求の範囲】

【請求項1】電解質透過性で非電子伝導性のセパレータの両面に活性炭とフッ素樹脂からなる連通孔を有する多孔体と電解液とからなる分極性電極を設け、その分極性電極の表面に集電極を設けた電気二重層キャパシタ。

【請求項2】電解質透過性で非電子伝導性のガラス繊維布からなるセパレータの両面にフェノール樹脂系の活性炭とフッ素樹脂からなる連通孔を有する多孔体とテトラエチルアンモニウムフルオロボレートとプロピレンカーボネートからなる電解液とからなる分極性電極を設け、その分極性電極の表面にアルミニウムからなる集電極を溶射法で設けた電気二重層キャパシタ。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】本発明は電気二重層キャパシタに関するものである。

## 【0002】

【従来の技術】この種の電気二重層キャパシタとして要部断面が図2に示す構成のものがある。同図において、電解質透過性で非電子伝導性のポリプロピレンからなるセパレータ1を挟んで活性炭2とポリビニールピロイドンからなるバインダ3と電解質4とプロピレンカーボネートからなる溶媒（図示せず）からなる分極性電極5を設け、分極性電極5の表面に金属フィルムからなる集電極6を設けた構成であった。この構成において、集電極6に直流電圧を印加すると分極性電極5内の活性炭2と電解液の界面に電気二重層ができて大容量の蓄電をするようになっていた。

## 【0003】

【発明が解決しようとする課題】しかしながら、上記のような構成ではバインダ3の自己形状保存能を補うために厚さ20～50 $\mu\text{m}$ の金属フィルムからなる集電極6を用いるためエネルギー密度が6 J/cm<sup>2</sup>と低いこと、分極性電極5が活性炭2、バインダ3、電解質4との混合物のために電解質が分極性電極の内部に浸透にくく120Hzにおける内部インピーダンスが1 $\Omega$ と高いという問題があった。

\*【0004】本発明は上記の問題を解消し、エネルギー密度が高く、内部インピーダンスの低い電気二重層キャパシタの提供を目的とする。

## 【0005】

【課題を解決するための手段】上記の目的を達成するために本発明の電気二重層キャパシタは、電解質透過性で非電子伝導性のセパレータの両面に活性炭とフッ素樹脂からなる連通孔を有する多孔体と電解液とからなる分極性電極を設け、その分極性電極の表面に集電極を設けた構成とする。

## 【0006】

【作用】上記構成により、分極性電極の自己形状保存能が高くなり、集電極の厚さを低減できるとともに電解質が分極性電極の内部に浸透しやすくなる。

## 【0007】

【実施例】以下、本発明の実施例を添付図面にもとづいて説明する。

【0008】図1において、7は電解質透過性で非電子伝導性のガラス繊維布からなるセパレータである。8はフェノール樹脂系の活性炭9とフッ素樹脂10からなる連通孔11を有する多孔体12と、テトラエチルアンモニウムテトラフルオロボレートからなる電解質13とからなる分極性電極である。溶媒はプロピレンカーボネートであり、その1リットル容積中に0.1モルの電解質を溶解させてある。活性炭9とフッ素樹脂10の比率は重量比で1：9とした。

【0009】分極性電極8の表面には厚さ1 $\mu\text{m}$ のアルミニウムからなる集電極14をプラズマ溶射法で設けた。上記構成の電気二重層キャパシタによれば、分極性電極8に活性炭9とフッ素樹脂10からなる多孔体12を用いるので内部インピーダンスが低くなるとともに自己形状保存能が高くなり、集電極14の厚さは1 $\mu\text{m}$ 程度でもよいためにエネルギー密度が高くなった。

【0010】本実施例と従来例のエネルギー密度と内部インピーダンスの比較を（表1）に示す。

## 【0011】

## 【表1】

	エネルギー密度 (J/cm <sup>2</sup> )	内部インピーダンス ( $\Omega$ )
従来例	6.0	1.00
実施例	20.0	0.08

【0012】同表から明らかなように本実施例のエネルギー密度は従来例より3.3倍高く、内部インピーダンスは1桁以上低い。

【0013】なお、実施例においては活性炭としてフェ

※ノール樹脂系の活性炭を用いたが、これに代えてチョップ状カーボン繊維、ガラス状カーボン、グラファイト粉末等を用いても同様の効果が得られる。また、電解質としてテトラエチルアンモニウムテトラフルオロボレート



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を用いたが、これに代えてテトラエチルアンモニウムバークロレート等の電解質を用いても同様の効果が得られる。また、集電極としてアルミニウムを用いたが、これに代えてタンタル、チタン、酸化チタン、貴金属の酸化物等を用いても同様の効果が得られる。また、セパレータとしてガラス繊維布を用いたが、これに代えてポリプロピレン等の電解質透過性で非電子伝導性のセパレータを用いても同様の効果が得られる。

【0014】

【発明の効果】以上の説明から明らかなように、本発明の電気二重層キャパシタによれば、活性炭とフッ素樹脂からなる連通孔を有する多孔体と電解液からなる分極性電極を用いるので自己形状保存能が高くなり集電極の厚さを低減できるのでエネルギー密度が高くなるとともに電解質が分極性電極の内部に浸透しやすくなるので内部

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インピーダンスが低減できる。

【図面の簡単な説明】

【図1】本発明の一実施例における電気二重層キャパシタの要部断面図

【図2】従来の一実施例における電気二重層キャパシタの要部断面図

【符号の説明】

7 セパレータ

8 分極性電極

9 活性炭

10 フッ素樹脂

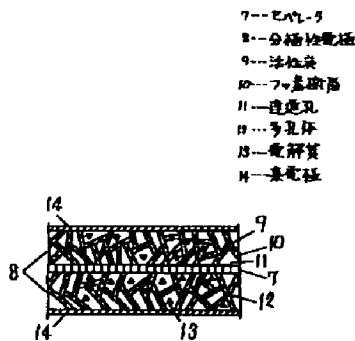
11 連通孔

12 多孔体

13 電解質

14 集電極

【図1】



【図2】

